cludes (*Real. Ist. Lomb. Rend.*) that surfusion of the raindrops is not indispensable to its production. Surfusion indeed accelerates it, as do also violence of wind and intense cold; but a rain with temperature not so low as zero falling into an air-current in rapid motion and below zero gives the phenomenon. It is pointed out, however, that the mist which usually accompanies verglas being driven against objects by the wind, and its particles being in a state of surfusion (the temperature being below zero), probably contributes to the general result, helping to make the ice-layer regular and uniform. If the verglas be such that the drop freezes wholly at once, the latter has probably contained many small crystals of ice.

M. MERCADIER sums up his researches on Radiophony by saying that he believes that the phenomena are due to a vibratory movement set up by the alternate heating and cooling, due to the intermittent beams of heat-rays, of the gaseous layer adjacent to the solid surface at which the radiations are absorbed; being an anterior layer in the case of solid bodies, a posterior layer in the case of transparent bodies.

M. JANSSEN has succeeded in photographing the *lumière cendrée*, or "earth-shine" on the moon when three days old: in the photograph the "continents" were to be distinguished clearly from the "seas." This disposes of the view sometimes advanced, and held, we believe, by some most eminent astronomers, that the "new moon in the arms of the old" was an optical illusion.

PROF. D. W. BEETZ, of the Technical High School of Munich, wishes us to say that in the note (vol. xxiii. p. 442) on the modulus of elasticity of rods of carbon, he, and not Herr Holtz, should have been mentioned as the author of the paper on the subject in *Wied. Ann.*

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday Mr. J. B. Minchin, who has spent some seven years in the country, read an excellent paper on Eastern Bolivia, which also included some observations on the Gran Chaco. After some preliminary remarks Mr. Minchin dwelt at length on the water-system of the country, and, speaking first of the lakes, he mentioned that between the Rivers Pilcomayo and Paraguay, in the unexplored Chaco, the Indians report the existence of a lake which no white man has ever yet seen, but which is perhaps near 22° S. lat. The rivers belong to Amazon and Plate systems, and with the exception of the Paraguay and the Itenez, they mostly have their sources among the highest summits of the Andes. The Parapite, Mr. Minchin added, is the most southerly affluent of the Amazons, which in some maps has been made to flow across the Chaco into the Paraguay. The Pilcomayo also does not, as has been thought, receive any tributaries on its course through the Chaco, so far as can be learned from the Indians. Mr. Minchin afterwards alluded to his expedition over the Matto Grossi Mountains, which he succeeded in crossing for the first time. The latter part of the paper was largely devoted to the animal and vegetable productions of Eastern Bolivia and to the commercial condition of the country. The discussion which followed turned chiefly on the route of the future into Bolivia, whether it would be most advantageous to follow the Paraguay route or develop a new one by the Madera.

MR. E. G. RAVENSTEIN has nearly completed for the Council of the Geographical Society the large map of Eastern Equatorial Africa, on which he has been engaged for nearly three years under the direction of their Scientific Purposes Committee. The original drawings will be reduced before they are engraved, and the map when published will be in twenty-four sheets, and on a scale of 1 : 1,000,000. It will take in the lake region, the Upper Congo, and the Upper Nile, and on the east coast will extend from Somali Land to a little south of the Zambesi, the precise limits of the map being from 10° N. to 20° S. lat., and from 25° to 52° E. long. A very complete bibliography of authorities, compiled *pari passu* with the map, will be published afterwards.

MR. BROUMTON, an agent of the China Inland Mission at Kweiyang-fu, in the province of Kweichow, has lately sent home an account of a visit which he had paid by invitation to the Miao-tsze tribes a short distance off. He had been told by one of them, from whom he had been learning something of the language, that in the third moon of the year his people had large gatherings in the hills, and was asked to be present at these festivities. He accordingly went and had an excellent opportunity for observing the manners and customs of this section of this comparatively unknown people. He describes their dress, the character of the festivities witnessed, the singular musical instruments used, &c. The particular tribes visited by Mr. Broumton are known as the Black (from the colour of their clothes) and the Ka-teo tribes, and live near Hwangping-chow.

MR. CARL BOCK is leaving for Siam next week, where he intends to make an excursion into the interior. His book, "The Headhunters of Borneo," will be published shortly by Messrs. Sampson Low and Co.

WE hear that Mr. Edward Whymper, who has already given an account of some phases of his South American journey to the Alpine Club and the Society of Arts, will read a paper on the Andes of Ecuador before the Geographical Society on May 9.

PRIZES OF THE PARIS ACADEMY OF SCIENCES

AT the public *séance* of the Academy on March 14 the annual distribution of prizes took place. While many of these prizes are offered for particular subjects, others are devoted to rewarding the most important advances made during the year in special departments of science.

The Grand Prize of the Mathematical Sciences was awarded to M. Halphen for work on the theory of linear differential equations.

In astronomy Mr. Stone receives the Lalande prize for his stellar researches, following those of Abbé de Lacaille, at the Cape of Good Hope; and the Valz prize goes to M. Tempel for his observations on comets. M. Vinot's labours in starting and editing *Le Ciel* are recognised by the award of the Tremont prize.

The Montyon prize of the mechanical arts is given to M. Cornut for his study of the faults of iron plates; the Poncelet prize to M. Leauté for various works; while a recompense of 1500 francs on the Bordin foundation is given to M. Lan for improved modes of combustion, diminishing the trouble and harm from smoke, &c. (in steel heating). The extraordinary prize of 6000 francs (for improving the efficacy of naval forces), and the Plumey prize, are not awarded.

In physics we find a recompense of 3000 francs given to M. Ader, on the Vaillant foundation, for improvements in phonetic telegraphy. The grand prize for researches on elasticity of crystalline bodies is not awarded.

The Jecker prize goes to M. Demarçay for important work in organic chemistry; the Gegner prize to M. Jacquelain for skill in preparing a large number of substances in a pure state, &c.

Two prizes on the Bordin foundation are awarded in geology, one to M. Gosselet for a geological sketch of the North of France, the other to MM. Falsan and Chantre for their geological monography of ancient glaciers and erratic deposits in the middle of the Rhone Valley. Recompenses on the Gay foundation are awarded to MM. Delage and Chevremont for observations on movements of the coast-line in France.

In medicine and surgery three Montyon prizes are awarded: one to Dr. Charcot for his work on localisation of disorders of the brain; another to Dr. Sappery for researches on the lymphatic apparatus of fishes; the third to Dr. Jullien for important medical researches. On the Bréant foundation M. Colin is awarded 5000 francs for physiological researches. Dr. Segond receives the Godard prize for an important work in surgery; Dr. Quinand the Barbier prize for researches on the quantity of oxygen in human blood in health and in disease. The Dusgate prize (having regard to prevention of premature burial) is not given, but MM. Onimus, Peyrand, and Le Bon are recompensed for their researches. The Boudet prize is awarded to Prof. Lister.

In experimental physiology the Montyon prize is given to M. Bonnier for researches on the nectaries and colours of plants.

The Fons-Melicocq prize for botanical research in the north of France is gained by M. de Vicq; and M. de la Chapelle receives 1000 francs on the Desmazières foundation for studies on French cryptogams.

In anatomy and zoology the Grand Prize with reference to distribution of marine animals on the French coast is withheld.

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M. Grandidier gains the Savigny prize for researches on the fauna of Zanzibar and Madagascar; while the Thorel prize is awarded both to M. Vayssières and M. Joly, for observations proving a small animal found in streams to be the larva of an insect of the family of Ephemerans.

The Montyon prize for statistics goes to Dr. Ricoux for his "Figured Demography of Algeria."

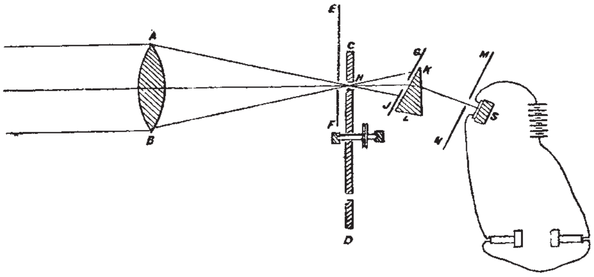
We further note that M. Birckel receives 1500 francs on the Montyon foundation, for an improvement in the Davy lamp, and that M. Dupuis receives the Delaland-Guerineau prize for his explorations in Tonkin.

The published list of subjects for prize competition in 1881, 1882, 1883, and 1885 comprises the following subjects (briefly stated) among others:—Motor for tramways; physiology of champignons; influence of environment on plant-organs; structure and development of cork; internal organisation of European edriophthalmate crustaceans; cure of Asiatic cholera; genito-urinary organs; revision of the theory of Jupiter's satellites; elasticity of crystalline bodies; origin of atmospheric electricity, and causes of electric phenomena in thunderstorms; inoculation as a prophylactic for domestic animals; coloured parts of the tegumentary system of animals, and fecundating matter of animated beings; marine, lacustrine, and terrestrial deposits on the French coast since the Roman epoch; botany of the North of France; diagnostic signs of death and prevention of premature burial.

MEASURING THE INDEX OF REFRACTION OF EBONITE[1]

PROF. BELL found that when an intermittent beam of light fell on a sensitive selenium cell the sound produced in a telephone (which with a battery was attached to the selenium) was not entirely destroyed by interposing a thin sheet of ebonite in the path of the intermittent rays of light, or, in other words, that ebonite was slightly transparent for invisible rays that affected selenium. It occurred to us some months ago that if such invisible rays were at all of the nature of light, they probably suffered retardation in passing through the ebonite, or that refraction would take place if the sheet of ebonite were replaced by an ebonite prism or lens, a result we have been able experimentally to confirm, and at the same time to measure the index of refraction.

A B is a glass lens concentrating a parallel beam coming from a lime-light on to one hole H in a rapidly revolving brass disk C D. This disk we have constructed many times as thick as the one employed by Prof. Bell, and have thus succeeded in eliminating all the sound produced by the syren action of the disk, so disturbing in delicate experiments. E F is a stationary zinc screen with a hole in it smaller than the holes in the rotating disk.



1. We first tried to focus these intermittent rays on a selenium cell by means of an *ebonite* lens, and so determine the focal length of the lens; but as our lens was then not mounted on an optical bench, so as to be moved parallel to itself, or rotated through known angles, and as the rays were invisible, so that our eyes could not of course guide us as to the proper position in which to put the lens, we failed to succeed in this very delicate experiment, which however our subsequent experiments, now to be described, show must ultimately succeed with the lens properly mounted.

2. A small portion of the intermittent light which passed through the hole H in the rotatory disk was allowed to fall on an ebonite prism K L, by passing through a slit in a zinc screen G J, the slit being arranged parallel to the edge of the ebonite prism. The prism employed had an angle of 27°·5. M N is another zinc screen with a slit in it also parallel to the edge of the prism, and placed in front of a sensitive selenium cell S (the cell described by us in the account of our experiments on "Seeing by Electricity"). This screen M N was moved parallel to itself, while an experimenter listened with a telephone to each ear, and who was placed in another room, so as not to be influenced by seeing what changes were being made in the position of the screen or in the position of the ebonite prism. The telephones had each a resistance of 74 ohms, and the battery an electromotive force of about 40 volts. No direct light falling on the selenium, the listener at the telephones heard nothing for the majority of positions of the screen M N, but in one position represented in the figure a faint distant sound was distinctly heard, which was entirely cut off by interposing the hand in front of the selenium, or by moving away the prism.

The invisible rays that affect selenium after passing through ebonite are consequently refracted, and some preliminary experiments, when the ebonite prism was arranged for minimum deviation, gave 1·7 as a first rough approximation for the index of refraction of these rays by ebonite. It is interesting to notice that the square, 2·89, of this index of refraction is between the highest and lowest limits obtained by different experimenters for the specific inductive capacity of ebonite, so far agreeing with Maxwell's electromagnetic theory of light.

We are now having prisms of ebonite and of other opaque substances of different angles mounted on a goniometer stand, to enable us to measure the indices of refraction accurately.

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[1] Note communicated to the Royal Society by Professors Ayrton and Perry.

MOLECULAR ELECTROMAGNETIC INDUCTION[1]

THE induction-currents balance which I had the honour of bringing before the notice of the Royal Society (*Proc.* Roy. Soc. vol. xxix. p. 56) showed how extremely sensitive it was to the slightest molecular change in the composition of any metal or alloy, and it gave strong evidence of a peculiarity in iron and steel which its magnetic properties alone failed to account for. We could with all non-magnetic metals easily obtain a perfect balance of force by an equivalent piece of the same metal, but in the case of iron, steel, and nickel it was with extreme difficulty that I could obtain a near approach to a perfect zero. Two pieces of iron cut off the same bar or wire, possessing the same magnetic moment, never gave identical results; the difficulty consisted, that notwithstanding each bar or wire could be easily made to produce the same inductive reaction, the time during which this reaction took place varied in each bar; and although I could easily change its balancing power as regards inductive force by a change in the mass of the metal, by heat or magnetism, the zero obtained was never equal to that obtained from copper or silver.

This led me to suppose the existence of a peculiarity in magnetic metals which could not be accounted for except upon the hypothesis that there was a cause, then unknown, to produce the invariable effect.

Finding that it would be impossible to arrive at the true cause without some new method of investigation, which should allow me to observe the effects from an electrical circuit, whose active portion should be the iron wire itself, I constructed an apparatus or electro-magnetic induction balance, consisting of a single coil reacting upon an iron wire in its axis, and perpendicular to the coil itself; by this means the iron or other wire itself became a primary or secondary, according as the current passed through the coil or wire. Now with this apparatus we could induce secondary currents upon the wire or coil, if the coil was at any angle, except when the wire was absolutely perpendicular; in this state we could only obtain a current from some disturbing cause, and the current so obtained was no longer secondary but tertiary.

The whole apparatus however is more complicated than the general idea given above, as it was requisite not only to produce effects, but to be able to appreciate the direction of the electrical current obtained, and have comparative measures of their value. In order to fully understand the mode of experiments, as well as the results obtained, I will first describe the apparatus employed.

The electro-magnetic induction balance consists—(1) of an

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[1] Paper read at the Royal Society, March 17, by Prof. D. E. Hughes, F.R.S.

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